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ALGEBRA.

98. Proposed by **B. F. FINKEL, A. M., M. Sc., Professor of Mathematics and Physics, Drury College, Springfield, Mo.**

A and B agreed to reap a field of grain for 90 shillings. A could reap it in 9 days, and they promised to complete it in 5 days; but B, who did not work as quickly ae he expected, was obliged to call to his assistance C, an inferior workman, who worked the last two days, in consequence of which B received 3*s*. 6*d*. less than would otherwise have been due him. In what time could B and C each reap the field? From *Milne's High School Algebra.*

I. Solution by O. S. WESTCOTT, Principal of North Division High School, Chicago, Ill.

Let x=time in which B could reap the field.

y=time in which C could reap the field.

Then $1/x+\frac{1}{9}=\dfrac{x+9}{9x}$=what A and B can do in one day.

$\therefore \dfrac{9x}{x+9}$=time in which A and B could do the work.

Now $90/x$ represents B's daily wages.

Therefore, $\dfrac{90}{x}\left(\dfrac{9x}{x+9}\right)$=what B should have received if A and B had together completed the job.

But $90/x\times5=\dfrac{450}{x}$ represents what B did receive.

Hence $\dfrac{90}{x}\left(\dfrac{9x}{x+9}\right)-\dfrac{450}{x}=3\frac{3}{4}$.

From which we obtain $x^2-87x=-1080$, and

$$x=\tfrac{87}{2}\pm\surd(-1080+\tfrac{7569}{4}),\quad x=\tfrac{1}{2}(87\pm57)=15 \text{ or } 72,$$

and since $\frac{5}{9}+5/x+2/y=1$, we have $\frac{5}{9}+\frac{5}{15}+2/y=1$ and $y=18$, or $\frac{5}{9}+\frac{5}{72}+2/y=1$ and $y=5\frac{1}{3}$.

But it is explicitly stated in the problem that C was the inferior workman; therefore the values $x=15$ and $y=18$ are the values sought.

Similar solutions were received from *COOPER D. SCHMITT*, *ALOIS F. KOVARIK*, *J. SCHEFFER*, *G. W. NASH*, and *J. M. BANDY*.

II. Solution by G. B. M. ZERR, A. M., Ph. D., Professor of Mathematics and Science, Chester High School, Chester, Pa.

In five days A does $\frac{5}{9}$ of the work and receives 50 shillings. B receives $40-3\frac{3}{4}=36\frac{1}{4}$ shillings for 5 days work, or $14\frac{1}{2}$ shillings for 2 days work.

$14\frac{1}{2}\div3\frac{3}{4}=\frac{29}{2}\times\frac{4}{15}=\frac{58}{15}$ times as many days for C to do the work as B.

Let x=number of days it takes B.

Then $58x/15$=number of days it takes C.

$\therefore 5/x+30/58x=\frac{4}{9}$.

$\therefore x=12\frac{12}{29}$ days, the time it takes B.

$58x/15=48$ days, the time it takes C.

Solved in like manner by *H. C. WHITAKER*, *P. S. BERG*, *B. F. SINE*, *J. F. TRAVIS*, and *P. H. PHILBRICK*.

NOTE.—This problem was proposed because we held that the wording of the problem was not sufficiently explicit. The fact that our contributors have taken the different views indicated by the above solutions confirms our opinion. The problem has been worded a little different in the last edition of Dr. Milne's Algebra. The wording of the problem is intended to lead to the first solution. B. F. F.

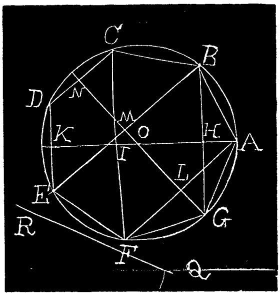
GEOMETRY.

122. Proposed by **G. I. HOPKINS, A. M.**, Professor of Mathematics and Physics, Manchester High School, Manchester, N. H.

If perpendiculars are dropped from the vertices of a regular polygon upon any diameter of the circumscribed circle, the sum of the perpendiculars which fall on one side of this diameter is equal to the sum of those which fall on the opposite side. [From Chauvenet's *Treatise on Elementary Geometry*.]

I. Solution by **HENRY HEATON, B. Sc.**, Atlantic, Ia.

Let $ABCDEFG$ represent a regular heptagon circumscribed by the circle whose center is O. Draw a diameter through A. It will be perpendicular to BG, CF, and DE, and it will bisect them in H, I, and K.



Draw any line RQ and for convenience call the perpendiculars from A, B, C, etc., upon RQ, a, b, c, etc. Then $b+g=2h$, $c+f=2i$, and $d+e=2k$.

Because K, I, H, and A are upon AK it can readily be shown that there is a point P upon AK such that $7p=2k+2i+2h+a=a+b+c+d+e+f+g$, and that this point is independent of the direction of RQ. In a similar manner it may be shown that there is a similar point p' upon the diameter through G, such that $7p'=a+b+c+d+e+f+g$. Hence $p=p'$. But this cannot be true without regard to the direction of RQ unless P and P' are at the intersection of the two diameters, that is, at the center. Hence the perpendicular from O upon any line RQ is one-seventh the sum of the perpendiculars a, b, c, d, e, f, and g. Hence if RQ passes through O, $a+b+c+d+e+f+g=0$.

It is evident that a similar demonstration may be made for any regular polygon.

II. Solution by **J. SCHEFFER, A. M.**, Hagerstown, Md., and **CHARLES C. CROSS**, Whaleyville, Va.

In a polygon of an even number of sides a diameter drawn through one of the vertices will pass through another vertex which will be symmetrical with reference to the center of the circle as the center of symmetry. Consequently, the sum of the perpendiculars drawn from the vertices on one side of any diameter will be equal to the sum of the perpendiculars drawn from the vertices of the